

REMARKS

In response to the final Office Action mailed July 10, 2008, and in view of the Request for Continued Examination (RCE) filed herewith, Applicant respectfully requests reconsideration. Claims 1-119 were previously pending in this application. By this amendment, Applicant is canceling claims 2 and 62 without prejudice or disclaimer. Claims 1, 7, 8, 11, 12, 13, 33, 44, 45, 61, 67, 71-74, 91, 93 and 117 have been amended. No claims have been added. As a result, claims 1, 3-61 and 62-119 are pending for examination with claims 1, 33, 61, 91 and 117 being independent claims. No new matter has been added.

Rejection Under 35 U.S.C. §102

The Office Action rejects claims 1-119 under 35 U.S.C. 102(e) as being anticipated by US Patent No. 6,477,398 (Mills). Applicant respectfully disagrees. In the "Response to Arguments" section on page 2, the Office Action asserts that Applicant's term "resonant property" is "overly broad and non-specific." While Applicant does not agree, the claims have been amended to recite "resonant frequency" in place of resonant property.

In Applicant's response to the previous Office Action, Applicant argued that the previous Office Action failed to specifically indicate where in Mills each limitation in the claims was shown, but rather cited large sections of the document that allegedly anticipated the claims. In the "Response to Argument" section, the current Office Action states:

The examiner has also provided additional specific examples of a few of the specific resonant properties and where they are found in the rejections of the independent claims below, as per applicant's request for additional citations of at least one specific example of a "resonant property" of the coil array 120. The resonant frequency shift calculated for each coil of the array, is one example of a resonant property of the coil array 120, which is determined / measured / calculated, for each coil enabling the property of magnetic susceptibility which is also inter-related to the resonant frequency or resonant properties of the coils and/or the subject being imaged.

Applicant respectfully disagrees for a number of reasons. First and foremost, Mills does not disclose determining a frequency shift of the coils, as asserted in the excerpt above. Rather, Mills teaches detecting frequency shifts in the Larmor frequency of atoms located at each voxel of the

object being imaged (see e.g., column 4, lines 14-20; column 5, lines 3-6; column; column 8, lines 14-18; and column 8, lines 24-31). The Larmor frequency is the rate at which a magnetized atom precesses about its axis of magnetization. This Larmor frequency depends, in part, on the strength of the magnetic field that is applied (column 3, lines 60-65). Accordingly, given a particular applied magnetic field strength, the Larmor frequency of the atoms, in the absence of other influences, is known. As Mills notes, the Larmor frequency also depends on the magnetic susceptibility of the tissue in each voxel region of the *object being imaged* (column 3, lines 60-65). That is, the Larmor frequency of atoms located at a particular volume (i.e., voxel) will shift as a function of the magnetic susceptibility of the tissue in the voxel region. Thus, what Mills is measuring is a shift in the Larmor frequency of the *atoms in the object*. Mills does not, however, measure a shift of the *resonant frequency of the coils*.

Second, the Office Action's assertion the "resonant property of the coil array 120, which determined / measured / calculated, for each coil enabling the property of magnetic susceptibility which is also inter-related to the resonant frequency or resonant properties of the coils and/or the subject being imaged" is not correct and not supported by Mills. In particular, the magnetic susceptibility is related to the Larmor frequency of the volume elements of the subject being imaged. Mills simply does not anywhere state that magnetic susceptibility is anyhow related to the resonant properties of the coils, nor does Mills anywhere described determining magnetic susceptibility by measuring changes in the resonant properties of coils. In fact, Mills does not even describe *using resonant coils as detector array 120 at all*, much less describe measuring changes in the resonant frequency of resonant coils to determine properties of the subject being imaged.

It should be appreciated that Mills describes an entirely different paradigm for obtaining information about an object, which results from measuring entirely different properties. Mills is based on measuring nuclear magnetic resonance (NMR) signals (column 3, lines 56-65). That is, the signals detected by Mills result from invoking the NMR effect of atoms. Mills notes that the Larmor frequency (i.e., the frequency with which atoms within the volume elements precess about an axis under the stimulation from an external field) of a small volume element of the subject will shift based on the magnetic susceptibility of the subject matter within the volume element (see e.g., column 4, lines 14-20; column 5, lines 3-6; column; column 8, lines 14-18; and column 8, lines 24-

31). Thus, if the shift of the Larmor frequency *of the atoms in a voxel* can be determined, the magnetic susceptibility can be computed. Mills clearly describes that it is the *shift in the Larmor frequency of the voxels* (i.e., a collection of small volume elements of an object; column 2, lines 52-54) that are being measured, not resonant frequency shifts of resonant coils.

Applicant's specification describes an entirely different paradigm. Rather than utilizing NMR or measuring signals emitted from a stimulated body, Applicant has discovered that properties of the body may be inferred from changes in the operating parameters of resonant coils in the presence of the body. While Mills measures signals emitted from a body being stimulated by a primary magnetic field, Applicant measures changes in the operating parameters of the coils themselves resulting from the presence of a loading body. Nowhere does Mills mention measuring a shift in the resonant frequency of an array of coils, or any other changes in the operating parameters of the coils. As discussed above, Mills nowhere describes the array of detectors 120 as being resonant coils (see column 12, lines 35-57 and column 25, lines 2-22), much less describing measuring a change in the resonant frequency of such coils. Mills simply does not disclose or suggest detecting a change in the resonant frequency of at least one of the resonant coils in the array resulting from the presence of the body, and therefore also does not disclose or suggest determining at least one electromagnetic property of at least one region of the body from the change in the resonant frequency of the at least one resonant coil.

A. Claims 1, 3-32 and claims 61, 63-90

Claim 1, as amended, recites method of determining one or more properties of a body positioned proximate an array of coils having a plurality of resonant coils, each having one or more resonant properties including a resonant frequency at which the respective coil was configured to resonate, the method comprising acts of detecting a change in the resonant frequency of at least one of the resonant coils in the array resulting from the presence of the body, and determining at least one electromagnetic property of at least one region of the body from the change in the resonant frequency of the at least one resonant coil.

Nowhere does Mills disclose or suggest "detecting a change in the resonant frequency of at least one of the resonant coils in the array as a result of the presence of the body" and therefore also does not disclose or suggest "determining at least one electromagnetic property of at least one

region of the body from the change in the resonant frequency of the at least one resonant coil,” as recited in claim 1. Therefore, claim 1 patentably distinguishes over Mills and is in allowable condition. Claims 3-32 depend from claim 1 and are allowable based at least on their dependency.

Claim 61, as amended, recites an apparatus for determining one or more properties of a body, the apparatus comprising a plurality of coils, each of the plurality of coils having one or more resonant properties including a resonant frequency at which the respective coil was configured to resonate, a first component coupled to the plurality of coils and adapted to provide at least one measurement of the plurality of coils indicative of a change in the resonant frequency of at least one of the plurality of coils resulting from the presence of the body, and a second component coupled to the first component to receive the at least one measurement, the second component adapted to determine at least one electromagnetic property of at least one region of the body based on the change in the resonant frequency.

Nowhere does Mills disclose or suggest “a first component coupled to the plurality of coils and adapted to provide at least one measurement of the plurality of coils indicative of a change in the resonant frequency of at least one of the plurality of coils as a result of the presence of the body” and therefore also does not disclose or suggest “a second component coupled to the first component to receive the at least one measurement, the second component adapted to determine at least one electromagnetic property of at least one region of the body based on the change in the resonant frequency,” as recited in claim 61. Therefore, claim 61 patentably distinguishes over Mills and is in allowable condition. Claims 63-90 depend from claim 61 and are allowable based at least on their dependency.

B. Claims 33-60 and 91-116

Claims 33 and 91 are directed to a method and apparatus, respectively, that determine properties of a body based on the coupling interaction between a plurality of coils as a result of the body operating as a load on the plurality of coils. While Applicant believes that claims 33 and 91, as originally presented, patentably distinguish over Mills, claims 33 and 91 have been amended to more clearly point out the distinctions. On Page 3 in the “Response to Arguments” section, the Office Action asserts:

In figure 13 each coil of coil array 120 is shown as sensor 110 which as drawn shows the coupled components of an individual sensor the ability to impedance match while minimizing resistive losses for the components of the antenna array as taught in col. 56 lines 26-56 which suggests at least 2 of a resistive coupling, a capacitive coupling and an inductive coupling between two or more of the plurality of coil elements in the coil array. [See figures 1a, 1b, 8 and especially figure 10 as well.] Therefore claim 99 is taught and/or shown by the Mills reference and this argument by applicant is also not persuasive.

Applicant respectfully disagrees. Column 56, lines 26-56 merely discusses a method to increase the signal to noise ratio by suppressing crosstalk. That is, crosstalk is “ameliorated or eliminated” by time multiplexing signal detection (col. 56, lines 26-56). As with most detector systems, Mills describes crosstalk between sensors as *noise* in the system – the opposite of information. Mills is not measuring the noise or any other coupling interaction between the sensors to determine properties of the object being imagined. In fact, Mills describes eliminating any such coupling or crosstalk because it registers as noise.

Applicant alone has recognized that the coupling between coils in the presence of a loading body may be used to determine properties of the body. In the entirety of Mills, the sensors are described as detecting the magnetic fields generated by the primary magnetic field and the secondary magnetic field generated by the magnetized body and the primary magnet. Nowhere does Mills use the *coupling between separate detectors* to determine properties of the body. In the excerpt cited by the Office Action, Mills merely describes a method of *eliminating crosstalk* and is completely silent with respect to measuring the coupling between coils and using these measurements to determine properties of the body.

Claim 33, as amended, recites a method of determining one or more properties of a body, the method comprising acts of positioning the body proximate a plurality of coils, measuring at least one property of at least one of the plurality of coils, the at least one property resulting from at least two of a resistive coupling, a capacitive coupling, and an inductive coupling between at least two of the plurality of coils as a result of operating at least one of the at least two of the plurality of coils, and determining at least one electromagnetic property of at least one region of the body from the at least one property.

Nowhere does Mills disclose or suggest “measuring at least one property of at least one of the plurality of coils, the at least one property resulting from at least two of a resistive coupling, a capacitive coupling, and an inductive coupling between at least two of the plurality of coils as a result of operating at least one of the at least two of the plurality of coils,” as recited in claim 33. Therefore, claim 33 patentably distinguishes over Mills and is in allowable condition. Claims 34-60 depend from claim 33 and are allowable based at least on their dependency.

Claim 91, as amended, recites an apparatus for determining one or more properties of a body, the apparatus comprising a plurality of coils, a first component coupled to the plurality of coils, the first component adapted to obtain at least one measurement of the plurality of coils, the at least one measurement indicative of at least two of a resistive coupling, a capacitive coupling, and an inductive coupling between two or more of the plurality of coils resulting from operating at least one of the two or more of the plurality of coils when proximate the body, and a second component coupled to the first component to receive the at least one measurement, the second component adapted to determine at least one electromagnetic property of at least one region of the body from the at least one measurement.

Nowhere does Mills disclose or suggest “first component adapted to obtain at least one measurement of the plurality of coils, the at least one measurement indicative of at least two of a resistive coupling, a capacitive coupling, and an inductive coupling between two or more of the plurality of coils resulting from operating at least one of the two or more of the plurality of coils,” as recited in claim 91. Therefore, claim 91 patentably distinguishes over Mills and is in allowable condition. Claims 92-116 depend from claim 91 and are allowable based at least on their dependency.

C. Claims 117-119

In both the current and previous Office Action, claim 117 has been rejected based on 22 column of disclosure, mostly mathematical in nature, without specifically identifying the subject matter the Office Action believes discloses each limitation in the claims. In the “Response to Arguments” section, the Office Action states:

...the matrix formed within the electronic computer processor to map out the resonant frequency shift for each of the detector / sensor coils of the array in determining the magnetic susceptibility map is an electromagnetic model of the coil

array which receives an induced current having an impedance as per col. 56 lines 26-56, and stores an induced voltage as a function of time.

Not only is this an inaccurate description of what Mills discloses in col. 56 lines 26-56, what Mills actually discloses in this excerpt does not meet a single limitation in claim 117. First, as discussed above, Mills does not measure frequency shifts of the detector – Mills measures shifts in the Larmor frequency of the atoms in the subject being imaged. Second, with all due respect, Applicant has no idea what the Office Action means by “the magnetic susceptibility map is an electromagnetic model of the coil array which receives an induced current having an impedance.” Not only is it unclear how a current can have an impedance, but it is entirely unclear how any of this relates to the disclosure in col. 56 lines 26-56. The cited excerpt describes a method of reducing crosstalk between detectors to increase the signal to noise ratio by a number of methods: 1) isolation via a Faraday cage; and 2) time multiplexing the signal detection of the detectors. None of this has anything to do with the subject matter recited in the claims, and specifically, it has nothing to do with defining an electromagnetic model of the coil array.

While Applicant believes that claim 117, as originally presented, distinguished over Mills, claim 117 has been amended to more clearly recite at least some of these distinctions. First, claim 117 has been amended to recite “an electromagnetic model of the coil array, the electromagnetic model of the coil array capable of generating a trial impedance matrix that simulates the impedance response of the coil array based on input electromagnetic properties assigned to a volume incorporated in the model.” The specification describes defining such a model and simulating it, for example, on pages 21 and 22. Mills simply does not compute his magnetic susceptibility maps in this way, but rather uses more conventional Fourier Transform reconstruction using matrix inversion. Nowhere does Mills disclose defining such an electromagnetic model of the coil array, particularly not in the cited excerpt.

Furthermore, in the “Response to Arguments” section, the Office Action asserts that the “other limitations of claim 117 come from the teachings of col. 30 line 5 – col. 32 line 46 where the iteration or trials and errors for each coil are performed until the magnetic susceptibility map properly representing the contribution of each coil is obtained based on specific limit tolerances. While this excerpt does indeed describe how Mills computes the magnetic susceptibility map, it is

not even close to what is recited in claim 117. The Office Action nowhere indicates what disclosure allegedly meets which limitations in the claims.

Most notably, the Office Action fails to disclose what in Mills meets “receiving an input including a measured impedance matrix of the coil array, the measured impedance matrix representing impedance measurements of the coil array obtained by operating at least one of the plurality of coils in the coil array.” There is nothing in this excerpt or the entirety of Mills that discloses a “measured impedance matrix,” particularly a measured impedance matrix representing impedance measurements of the coil array obtained by operating at least one of the plurality of coils in the coil array, as recited in claim 117.

The Office Action fails to disclose what in Mills meets “assigning trial values respectively to each of the plurality of regions, the trial values representing initial guesses for values of at least one of conductivity, permittivity and permeability for each of the plurality of regions.” Mills nowhere discloses or suggests assigning trial values of conductivity, permittivity and/or permeability to each of a plurality of regions, much less “generating a trial impedance matrix from the assigned trial values according to the electromagnetic model of the coil array.” Mills does not define a model, does not assign trial values for the model to convert into a trial impedance matrix and Mills does not described “reducing a distance between the trial impedance matrix and the measured impedance matrix.” For each of these reasons alone, claim 117 patentably distinguishes over Mills and is in allowable condition. In order to anticipate a claim, a reference must disclose each limitation “arranged or combined the same way as in the claim” (*Connell v. Sears, Roebuck & Co.*, 722 F.2d 1542 (Fed. Cir. 1983)).

The Office Action has taken disclosure from different places of Mills describing different things that not only do not meet the limitations taken individually, but describe things that are not even related or relevant to the subject matter described in the claim as a whole. Accordingly, Applicant respectfully requests that the rejection of claims 117-119 under 35 U.S.C. §102 be withdrawn.

CONCLUSION

A Notice of Allowance is respectfully requested. The Examiner is requested to call the undersigned at the telephone number listed below if this communication does not place the case in condition for allowance.

If this response is not considered timely filed and if a request for an extension of time is otherwise absent, Applicants hereby request any necessary extension of time. If there is a fee occasioned by this response, including an extension fee, please charge any deficiency to Deposit Account No. 23/2825, Reference No. B0662.70056US01.

Dated: December 10, 2008

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